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BRIEF NOTE

LOCATION OF COAL MINE ROOF FALLS AND ASSOCIATED MINING OPERATIONS DURING FAILURE[1]

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Significant correlations between roof fall frequency in underground coal mines and mine geometry have been established by several researchers (Drury 1964, Peng 1978, Pothini and von Schonfeldt 1979). The most hazardous area in underground mining in terms of fatalities is the immediate area around the work face where there is the highest concentration of miners. Usually the first 8 — 10 m from the working face are found to be the most dangerous, regardless of seam height (Dougherty 1971, Moyer and McNair 1973). This close spacing of mine roof falls resulting in injury, possibly lethal, may be due to the increased activity in the immediate area of the coal face as compared with other areas in the mine.

Additional factors which contribute to potentially unstable roof conditions include geological disturbances in the immediate roof, such as overburden and/or interburden thickness and lithology, facies changes, and structural features located in the overlying strata, such as folds, faults, joints, slickenslides, paleochannels, scours, pinchouts, clay veins or dikes, crevasse splays, and kettlebottoms (Chase and Sames 1983, Iannacchione et al. 1981, McCulloch and Deul 1973, Moebs and Ellenberger 1982, Moebs and Ferm 1982). Also, as mining advances and extends the face, freshly exposed rock must adapt to its changing geostatic stress conditions. Thus, as the roof strata adjusts and reaches renewed equilibrium, failure may occur.

The next most frequent occurrence for mine roof falls and associated fatalities are found at room and entry intersections (Dougherty 1971, Peng 1978). Pothini and von Schonfeldt (1979) reported that 73% of recorded mine roof failures at Island Creek Coal Company occurred in four-way intersections, 11% in three-way intersections, and 16% in other areas. However, generally intersections make up no more than 15 — 20% of the total mine area but usually account for at least twice that percentage of reported roof-failure related deaths (Stahl 1972).

Location is not the only indicator of potentially unstable mine roof. Vibrations and blasting, which are related to the particular mining operations or methods in practice to extract coal, may lead to failure (Stehlik 1964). Blasting of coal and surrounding country rock may place high stresses on roof strata and, thus, adversely affect roof bolts and other support structures in the immediate roof. Blasting, usually associated with conventional mining operations, has been linked to loss of bolt tension, breaking and bending of bolts, and presence of fractures in the roof causing the immediate roof to lose its ability to support a load (Stehlik 1964). In addition, vibrations caused by machinery associated with mining operations may also lead to roof support failures. These vibrations are transmitted to bolt anchorage systems, for example, by the operation of continuous miners, roof bolting equipment, and various underground transportation systems, both for supplies and mineral haulage in the immediate area of the support system.

In order to investigate the relationships among mining operations, location of mine roof failure areas, and occurrence of roof falls, a total of 250 roof failures

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TABLE 1

Frequency counts and relative frequencies for locations of mine roof falls and associated mining operations at time of failure.

Measured Parameter		Absolute Frequency	Relative Frequency (%)
Mine Roof Fall Location			
Entry		101	40.4
Crosscut		35	14.0
Intersection		86	34.4
Haulage Road		20	8.0
Beltway		4	1.6
Airway		4	1.6
	Total	250	100.0
Operation at Time of Failure			
Continuous Miner		164	65.6
Bolter		2	0.8
Other or Specialized		13	5.2
Convention		47	18.8
Hand		5	2.0
Abandon		19	7.6
	Total	250	100.0

in 5 room-and-pillar mines of eastern Kentucky were measured. Table 1 displays the frequency distributions of the spatial location of these falls and type of major mining operation when the failure of the roof strata occurred. Continuous mining operations, which includes a single machine called a continuous miner that mechanically breaks up the coal and loads it while shuttle cars, scoops, or mobile conveyors carry the coal from the continuous miner to the mine-car loading point or conveyor beltline, accounted for approximately 66% of all operations at time of roof failure (table 1). Conventional mining, which involves the extraction of coal in a sequence of operations, including blasting in most cases, represented about 19% of operations during actual roof failure. Failure areas were mainly located in entries (40.4%), intersections (34.4%), crosscuts (14.0%), and miner and supplies haulage areas (8.0%).

As evident from a simple analysis of the measured falls, the typical failure in the traditional room-and-pillar mines located in the Eastern Kentucky Coal Field occurred in entries or intersections and continuous mining methods were employed at the time of the fall, assuming that the sample is representative of the Eastern Kentucky Coal Field. Hence, with the increased use of continuous methods of coal extraction, monitor programs outlining the potential locations of failure areas in entries and intersections near the face should be emphasized in American coal mines.

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